



Climate change mitigation for agriculture: Water quality benefits and costs

Author(s): Wilcock R, Elliott S, Hudson N, Parkyn S, Quinn J
Year: 2008
Journal: Water Science and Technology : A Journal of The International Association on Water Pollution Research. 58 (11): 2093-2099

Abstract:

New Zealand is unique in that half of its national greenhouse gas (GHG) inventory derives from agriculture--predominantly as methane (CH₄) and nitrous oxide (N₂O), in a 2:1 ratio. The remaining GHG emissions predominantly comprise carbon dioxide (CO₂) deriving from energy and industry sources. Proposed strategies to mitigate emissions of CH₄ and N₂O from pastoral agriculture in New Zealand are: (1) utilising extensive and riparian afforestation of pasture to achieve CO₂ uptake (carbon sequestration); (2) management of nitrogen through budgeting and/or the use of nitrification inhibitors, and minimizing soil anoxia to reduce N₂O emissions; and (3) utilisation of alternative waste treatment technologies to minimise emissions of CH₄. These mitigation measures have associated co-benefits and co-costs (disadvantages) for rivers, streams and lakes because they affect land use, runoff loads, and receiving water and habitat quality. Extensive afforestation results in lower specific yields (exports) of nitrogen (N), phosphorus (P), suspended sediment (SS) and faecal matter and also has benefits for stream habitat quality by improving stream temperature, dissolved oxygen and pH regimes through greater shading, and the supply of woody debris and terrestrial food resources. Riparian afforestation does not achieve the same reductions in exports as extensive afforestation but can achieve reductions in concentrations of N, P, SS and faecal organisms. Extensive afforestation of pasture leads to reduced water yields and stream flows. Both afforestation measures produce intermittent disturbances to waterways during forestry operations (logging and thinning), resulting in sediment release from channel re-stabilisation and localised flooding, including formation of debris dams at culverts. Soil and fertiliser management benefits aquatic ecosystems by reducing N exports but the use of nitrification inhibitors, viz. dicyandiamide (DCD), to achieve this may under some circumstances impair wetland function to intercept and remove nitrate from drainage water, or even add to the overall N loading to waterways. DCD is water soluble and degrades rapidly in warm soil conditions. The recommended application rate of 10 kg DCD/ha corresponds to 6 kg N/ha and may be exceeded in warm climates. Of the N₂O produced by agricultural systems, approximately 30% is emitted from indirect sources, which are waterways draining agriculture. It is important therefore to focus strategies for managing N inputs to agricultural systems generally to reduce inputs to wetlands and streams where these might be reduced to N₂O. Waste management options include utilizing the CH₄ resource produced in farm waste treatment ponds as a source of energy, with conversion to CO₂ via combustion achieving a 21-fold reduction in GHG emissions. Both of these have co-benefits for waterways as a result of reduced loadings. A conceptual model derived showing the linkages between key land management practices for greenhouse gas mitigation and key waterway values and ecosystem attributes is derived to aid resource managers making decisions affecting waterways and atmospheric GHG emissions.

Source: <http://dx.doi.org/10.2166/wst.2008.906>

Resource Description

Exposure :

weather or climate related pathway by which climate change affects health

Ecosystem Changes, Food/Water Quality, Food/Water Security

Food/Water Quality: Chemical, Pathogen

Geographic Feature:

resource focuses on specific type of geography

Freshwater

Geographic Location:

resource focuses on specific location

Non-United States

Non-United States: Australasia

Health Co-Benefit/Co-Harm (Adaption/Mitigation):

specification of beneficial or harmful impacts to health resulting from efforts to reduce or cope with greenhouse gases

A focus of content

Health Impact:

specification of health effect or disease related to climate change exposure

Health Outcome Unspecified

Intervention:

strategy to prepare for or reduce the impact of climate change on health

A focus of content

Mitigation/Adaptation:

mitigation or adaptation strategy is a focus of resource

Adaptation, Mitigation

Resource Type:

format or standard characteristic of resource

Review

Timescale:

time period studied

Time Scale Unspecified